



# The Value of a Sustained Maintenance Program

*A Lesson Learned the Hard Way*

## Senior Management ViTS Meeting

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[sma.nasa.gov/safety-messages](http://sma.nasa.gov/safety-messages)

# Overview

## Transonic Dynamics Tunnel (TDT) Cooling Coil Breach/Water Intrusion

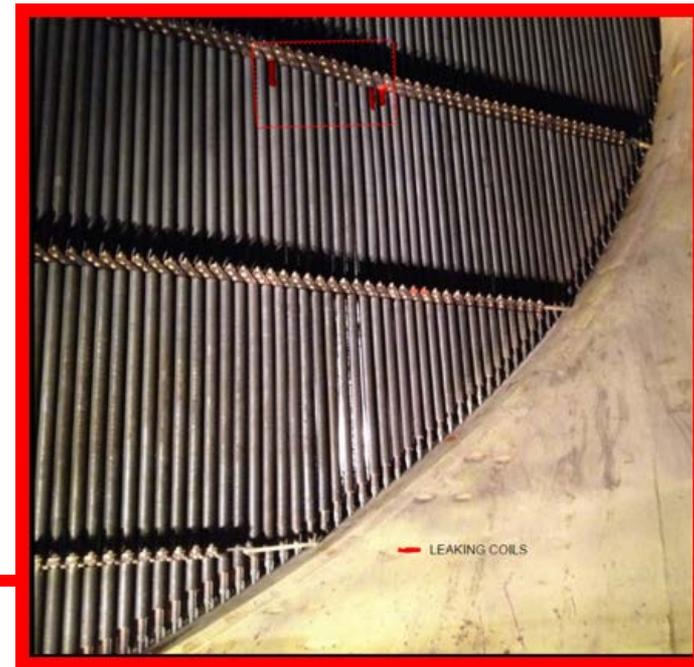
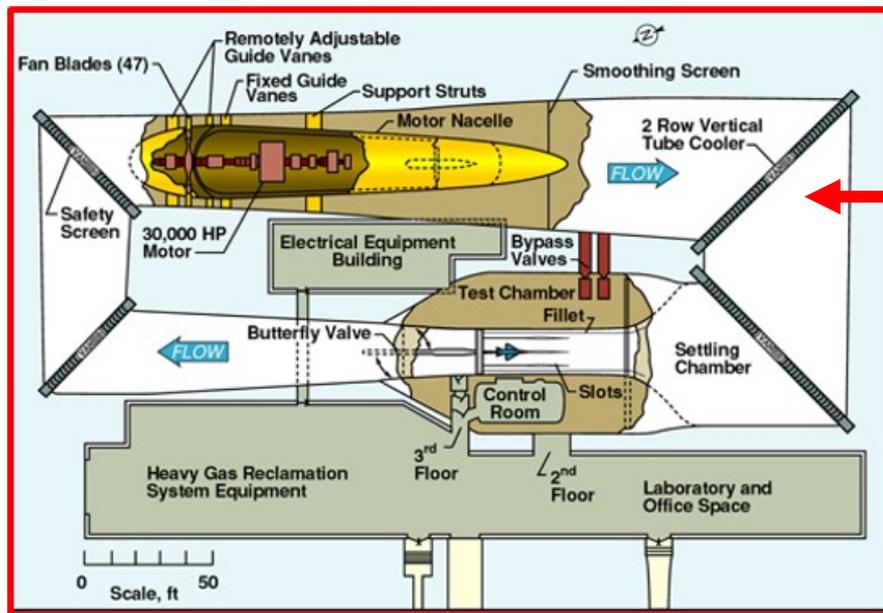
- Due to a series of tunnel cooling water systems failures coupled with unseasonably low temperatures, the TDT Cooling Coil was breached.
- The breach occurred during sub-atmospheric (R-134a) testing, therefore tunnel circuit could not be readily accessed.
- Cooling water was pumped and sucked into the tunnel circuit through breach and subsequently ingested in R-134a Reclamation System.
- Over 100,000 gallons of water was introduced into the tunnel circuit before the flow could be controlled.
- The tunnel was inoperative for almost two months after the mishap.



**Facility: Building 648**  
**Mishap Date: Jan. 23, 2014**  
**Mishap Classification: Type C**  
**NMIS: MIG-11549**

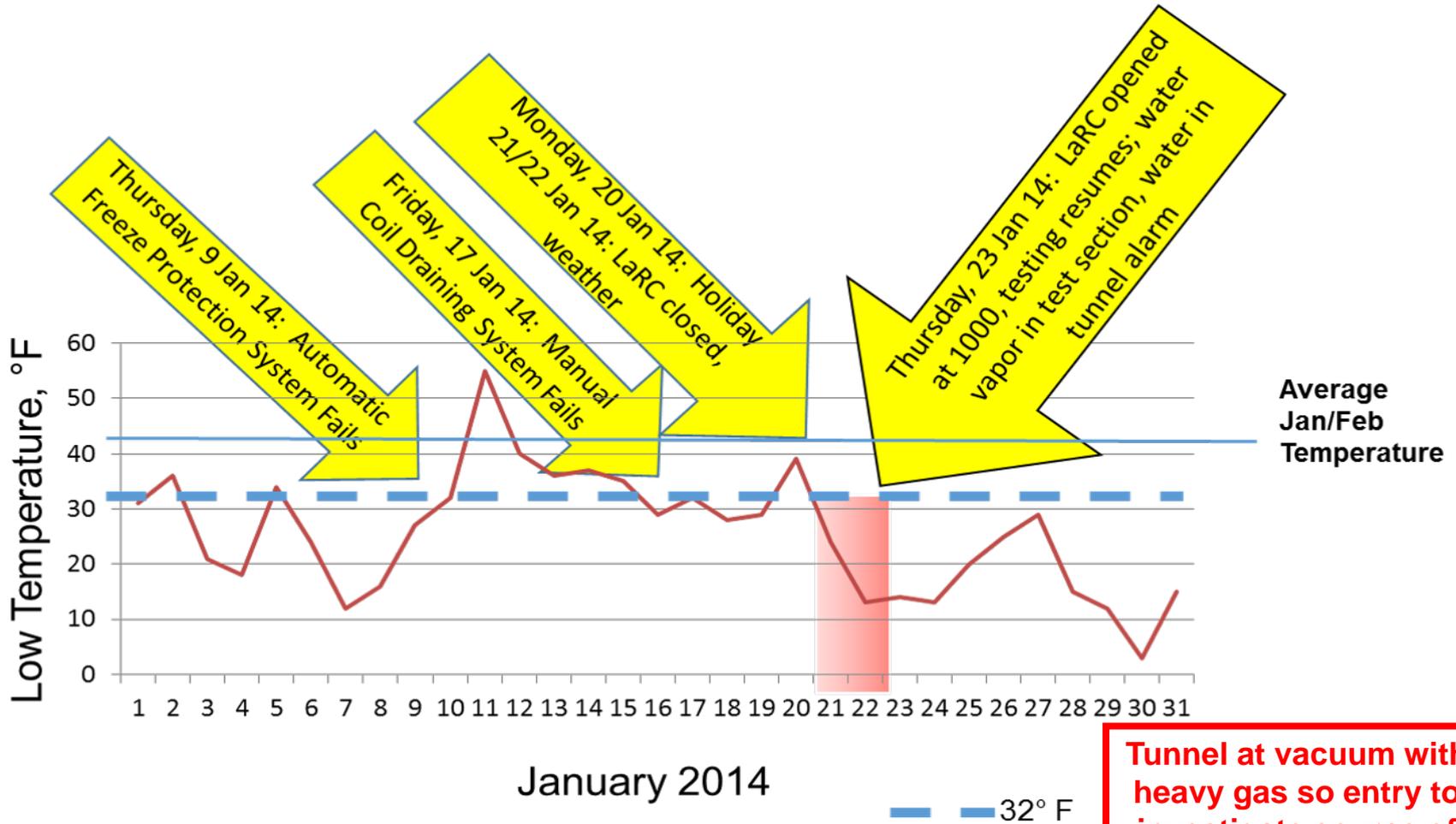
**Investigation Team:**  
**Roger Wagner, RD (Chair)**  
**Scott Colbert, RD**  
**Charles Poupard, SFAB**

# Overview



Cooling Coil (downstream view)

# Event Timeline Relative to Daily Low Temperature



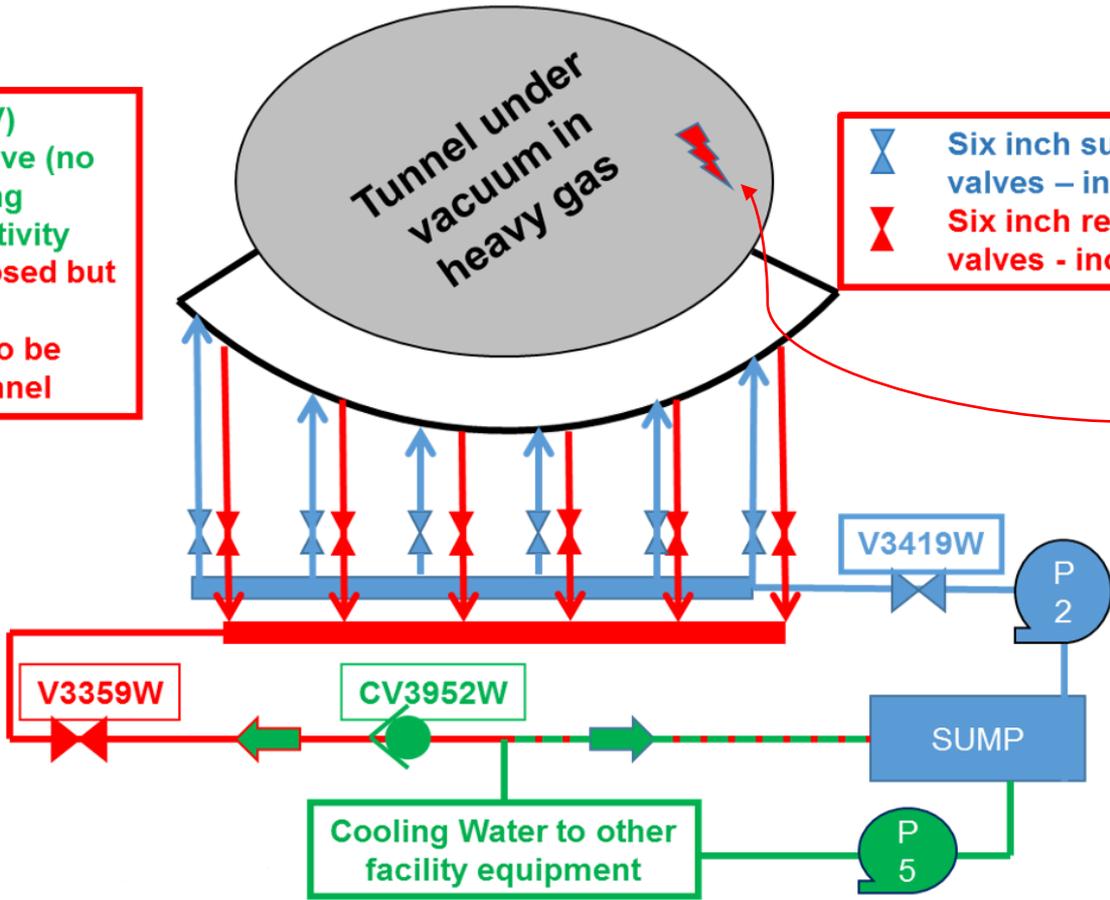
**Tunnel at vacuum with heavy gas so entry to investigate source of water not possible**



# Jan. 26, 2014: Introduction of Water

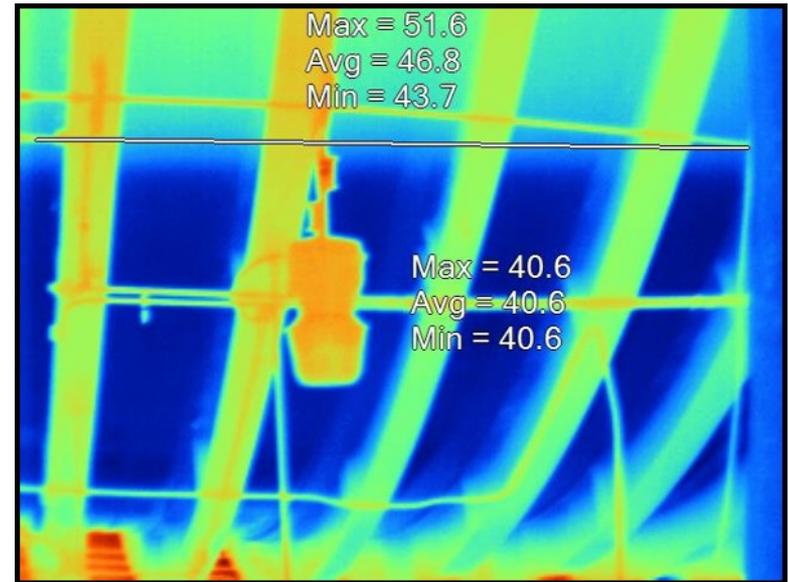
- Check Valve (CV) 3952W inoperative (no flappers) pending maintenance activity
- Valve 3359W closed but leaked by valve allowing water to be pumped into tunnel

- ⌵ Six inch supply side gate valves – inoperative
- ⌴ Six inch return side plug valves - inoperative



**Burst Coil**

# Jan. 27, 2014: Water Intrusion Evidence



**Thermal imaging used to show water levels in the tunnel**

Water in the tunnel was quickly recognized; however, mitigating the leak was challenging due to cold temperatures compounded by the sub-atmospheric state of the tunnel.

# Impact: Type C Mishap, Significant Delay, Lost Opportunity

## Maintenance and Repair (Type C Mishap)

- Over \$60,000 was spent to repair the tunnel and return it to service.
- Approximately \$250,000 was spent to return facility to normal operational status:
  - Repairs involved the cooling coil, freeze protection system, valves and associated piping, and evaluating deteriorating components (water box, thermal study, etc.)

## Customer testing impacted

- The NASA/Boeing Truss Braced Wing Test was delayed 60 days.
- The result was 60 days of potential revenue lost due to the non-operational facility:
  - A 12-hour testing day is equivalent to approximately \$37,000 of lost daily revenue.
  - With the facility operational five to six days per week, the potential lost revenue ranged between \$1,600,000 to \$1,900,000.
  - *No additional tests for revenue were proposed during this period.*

## Follow-on schedule

- All check standard testing was cancelled in FY 2014 in order to accommodate the remainder of customer testing.
- Normally, four check standard tests are conducted per year in order to validate tunnel health and data acquisition systems.

# Summary

**The root cause of the TDT cooling coil breach and associated water intrusion was a lack of facility preventative maintenance caused by a reduction in budget.**

- Independent and piecemeal maintenance decisions increased risk.
  - Over time, fiscally sound decisions to not perform maintenance (i.e., run-to-fail strategy) caused degradation in a low-risk system.
  - The increased risk of the accumulation of individual minor maintenance problems was recognized. But reduced funding did not provide for action, resulting in more risk to the facility than desired.
- Unseasonably cold temperatures contributed to exposing the risk of decreased maintenance on a low risk system.
  - Langley Research Center is exposed to this environment less than five percent of an average year.



**Freeze Protection Piping**



**Six-Inch Plug Valve**



**Six-Inch Gate Valve**